THE SCOPE

SEPTEMBER

1936

THE SCOPE

Published by the Students of the
Massachusetts School of Optometry
Boston, Mass.

Code of Ethics

American Optometric Association

Adopted — June 1935, Miami, Florida

(1). THE OPTOMETRIST SHALL KEEP INVIOLATE ALL CONFIDENCES COMMITTED TO HIM IN HIS PROFESSIONAL RELATIONSHIP WITH HIS PATIENT.

(2). IT SHALL BE THE DUTY OF EVERY OPTOMETRIST TO SUPPORT ORGANIZED OPTOMETRY IN ITS EFFORTS TO ADVANCE AND PROMOTE THE HIGHEST IDEALS OF PROFESSIONAL SERVICE.

(3). IT SHALL BE AN OPTOMETRIST'S DUTY TO REFRAIN FROM ANY EXAGGERATION OF A PATIENT'S CONDITION.

(4). IT IS THE DUTY OF EVERY OPTOMETRIST TO KEEP HIMSELF INFORMED AS TO EVERY DEVELOPMENT IN HIS PROFESSION BY ALL MEANS WITHIN HIS POWER AND TO CONTRIBUTE HIS SHARE TO THE GENERAL KNOWLEDGE AND ADVANCEMENT OF THE PROFESSION.

(5). IT IS THE DUTY OF EVERY OPTOMETRIST TO REFRAIN FROM ALL CRITICISM REFLECTING UPON THE SKILL OF A COLLEAGUE.

(6). ALL OPTOMETRISTS SHALL REFRAIN FROM ADVERTISING, EXCEPT THAT PERMITTED BY THE CODE OF ETHICS OF HIS RESPECTIVE STATE ASSOCIATION.

(7). IT SHALL BE CONSIDERED UNETHICAL FOR AN OPTOMETRIST TO BE EMPLOYED EXCEPT AS AN ASSOCIATE OF A REGISTERED OPTOMETRIST.

THE SCOPE

VOL. IX SEPTEMBER, 1936 No. 1

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Editorial

OFF Then, THE SCOPE, to yet another start with a new staff of chaps all eager to research and scribble their bit.

In policies, the old order shall prevail with a conservative here, a reactionary and non-conformist there, all carefully chosen from the student body to represent its collective interests in both academic and professional spheres.

Believing that all that will be done to fashion the optometry of the future shall be done in her colleges, these men shall devote themselves not only to the sifting and publishing from the wealth of independent research and practice the constantly accumulating data and new thought, but also to making it possible for the student to express, and thus identify himself with the constant flux of scientific entities.

The latter notion, it would seem, should be of greatest import, for unless the modern temper of the of the embryo Optometrist can be sought out, studied, and stabilized by proper enlightment, what tremendous efforts in the art and science of the profession are achieved can only prove futile.

To the gentlemen, who devoted themselves so loyally to the SCOPE'S interests last season we say, wholeheartedly and without mental reservation: Best ever!!! and as we take up the task it is with one thought: To Carry On.

J. C. R.

Freshmen We Welcome You

As upperclass men we extend a hand of greeting to you who are about to enter the field of Optometry. You have chosen the Massachusetts School of Optometry as the medium by which you will endeavor to attain the goal in your chosen profession. The choice of a lifework is more or less of a speculation. We, as advanced students, being well acquainted with the admirable standards and innate traditions of our school, are confident you will have no reason to regret your choice but rather, will be encouraged and inspired as the year continues.

As you proceed in your curriculum, constantly acquiring knowledge and ever gaining confidence, it is inevitable that you will come to realize the significance and importance of this fine and noble profession. You cannot fail to recognize the opportunities it presents to the zealous student and to acknowledge the fact that to the one who is ready to devote his time and apply his efforts in mastering its problems, will come ample reward at the culmination of his course.

Mould your individuality and employ your mental capacity so that you may achieve that success which is within your power to grasp. Avail yourself of the innumerable advantages and facilities before you. This is a duty, both to yourself and to your school.

Our institution boasts a splendid staff of instructors, well versed in their subjects. Do not hesitate to prevail upon them for aid in solving your problems. You will find them willing and eager to do their utmost to erase any doubt or complexity from your mind. Present your difficulties to them and be convinced of their understanding and interest in you by the splendid co-operation extended.

As individuals you constitute the future Optometrists of America, in every corner of the country you will represent your profession, further its progress and more firmly establish it in its own niche throughout the professional world.

The success or failure of your career depends largely upon what you accomplish during your school years. The initial year, particularly, is consequential in laying the foundation for your future and granting you the benefits derived from a "good beginning." Make the most of this year—its place is one of primary significance in your school course.

Facilities are offered which make it possible for you to realize the fondest of ambitions and aspirations. In return, show your appreciation and school spirit by responding whenever the opportunity presents itself. Assume the proper attitude toward school and classmates, proving your compatability and desire to co-operate.

To each and every one of you we wish the best of luck and boundless courage in your new undertaking.

Mental Hygiene In Optometry

by ALFRED ROY

The demonstration of a certain aspect of mental hygiene as an aid in the practice of Optometry.

The state of so-called mental-health is one that has certain unmistakable outward signs upon the individual. For the refreshments of the reader's memory, let me review these objective signs. In general, a person with a fair degree of mental health can be said to be happy. This in itself embraces a vast category of symptoms which are quite familiar to the reader. In explanation it would be enough to remark that this individual is contented with his lot, insomuch as he is not at odds with that particular required behavior-pattern of the social position that he occupies. The particular mentality of the individual in question may not be one that would normally permit the unquestioned following of such a code, but, by compensation and adjustment of the said mentality (not necessarily deadening), the social position is realized as well as the need of conforming to a certain standard for the progression of the common good and another solid citizen falls in line. In further detail, the mentally healthy person also presents a minimum of the fixed phobias of various origin and direction which normally betray themselves in (mild form) introvertism, snobbishness, nervous hyper-irritability, exhibitionism, immorality, etc, etc. The particular point, regarding this subject, is that the mentally healthy person is quite sympathetic and is very able to forget self and assume, for the moment, the other fellow's personality; "putting himself in the other fellows position" as common usage will have it. We shall, for the present, waive all other companion symptoms and keep in mind the last mentioned.

The practice of Optometry is necessarily limited to the understanding of the patient's symptoms, both objective and subjective, their interpretation and the correct application of prescribed although variable remedies for the relief of the trouble or the invalidating of the cause of the discomfort. The latter parts are concerned with Optometry, which is necessarily bound up in our discussion, but, in this paper, the more psychological approach shall be dealt with.

Let us consider an average case:—

The patient has come with ocular discomfort. He has visited the Optometrist for the sole purpose of relieving his ailment. He has no knowledge of Optometry and is not going to try to use anything but his own language in the relation of his symptoms. Moreover, he is scared stiff and is trying not to show it.

Here is the Optometrist's job and here is where the application of the right kind of mental hygiene can be of some use to the Optometrist in his relation to the patient. These principles will make the professional mind more able to understand the vague and frightened quiverings on the part of the patient. It will tend to make the Optometrist more a part of his work, as will be seen in the following explanation.

At this point it is found necessary to digress, with a little warning. A state of mental health is one where the normal procedure of events is not hindered by the presence of severely cramping fixations and neuroses. Such curbing influences tend to fix the mental sensitivity of the Optometrist, for example, to such a small sphere that only a few, if any, of his patients are encompassed. Of course, the widest possible scope is criterion. In these matters where the fixations are not too severe, the individual can combat and escape but in the more grave cases the services of a psychiatrist should be requested, for the individuals own happiness, if for nothing else. However, let not the reader be frightened for fear of harboring some obscure associated-conditioned perverted reflex, for it is held by substantial authority that 90% of the total population are at or near normality, al-

though most of us are victims of slight "idiosyncrasies".

Arbitrarily assuming, then, that the mentally healthy Optometrist is confronted by the test case. The procedure can be called a set of mental exercises performed by the Optometrist and carried out to the best of his ability. The goal of the idea is to live the patient's life, so to speak, while the patient is in the chair. These exercises need not be evident to the patient more than an exhibition of genuine sympathy coupled to a polite and searching inquiry from the Optometrist.

1. As soon as the patient comes in and approaches the opthalmic chair, the Optometrist should judge the patient's mental attitude, aiding the analysis by questions of general interest. The composure of the patient should be assured by a friendly interest.
2. When the patient has been at the chair for a few moments and has had a chance to look around and become orientated, the Optometrist should ask himself,

   "Am I sure that the patient is at ease?"

   If not, then more effort should be expended to that end. There is no way that a patient can be judged in this respect except in the intuition of the Optometrist. Intuition, let it be said, is a super-intelligence that is seen in the judgement of people having, as a rule, minds that are at ease (healthy minds).
3. When the patient has started to expand and regard the man-in-white as a friend, he is fertile ground for a good start. Now the pertinent questions of occupation, interests and symptomata etc, etc, can be asked. The mental question should be,

   "If I had his position, his age, his troubles and his terrible Rx, would these be my complaints, knowing what I know?"

   This, it is seen, is the start of the procedure of assuming the patient's burden of life and trying to help him by comparing the trained interpretation with the untrained. The process is tiring only to the Optometrist.
4. All through the examination, the Optometrist is thus doing the patient's thinking. The patient, naturally, seeing the care being taken in his case, imagines himself to be something special and thanks his lucky stars that he came to this particular gentleman. In addition to the above, the Optometrist should ask himself,

   "Am I giving this type patient the necessary attention and is my treatment instilling the proper confidence, if not, am I not working in the wrong direction?"

   The answer to this question is a book in itself. However, as this paper is not necessarily concerned with proper procedures and adjustment in doctor-patient relations, I shall leave the details to the discretion of the Optometrist. My purpose is to create an awareness of the advantages of mental-training by self-transference. It would not be amiss to say that such training would result in a very successful practice due to the super-confident patients.

In like manner, through the entire examination, the mental comparison can be maintained by the Optometrist. A few days practice will result in such a degree of ability of transference that the Optometrist will find that his rather tedious procedure, that of testing eyes, has become the most fascinating and varied pastime imaginable. The host of satisfied and confident patients leaving the door will assure the return of their friends to the splendid man-in-white who dispenses Optometric services and gives confidence.

A word of warning:—

Too many questions tire the patient; too few do not serve, try for the happy medium.

Bbl; Ward, Wallin, Adler-Freud.

The Junior

"A face once seen — and never remembered." —Oscar Wilde.

Last year's Freshmen pass on, relegated to that limbo of lost souls—the Junior Class. This may appear to some to be an inane observation, based perhaps on insufficient experience or a biased view-point, but, truly, the last Junior Class did seem to us a veritable "lost battalion". It really seemed as if all the zest, all the relish, all the tang of extra-academic school-life was contributed mainly by the Freshmen and Seniors, and that the Juniors were—well, just Juniors, just so much roughage, to use a rather weak dietetic allusion.

Their situation was somewhat analogous to that in which little Jr. finds himself upon the arrival of a new baby brother or sister (Freshmen). All that wealth of affection and attention that he has been accustomed to is shifted almost entirely to the newcomer; and his reaction is to pout and sulk, crawl into his shell, so to speak—a case of chronic, temporary introversion, or perhaps a subconscious bid for sympathy.

Whatever you call it—a lethargic languor, a soporific stupor, or any other pretty alliterative appellatives—it seems to be an inherent trait of most Junior Classes. Perhaps it is an unavoidable effect of natural causes. For the Freshmen, there is that glorious thrill and anticipation of new friends, new surroundings, new work, etc. For the Seniors, there is that feeling of pride and relief, that worst-is-over feeling that follows the completion of two long, hard years of unremitting application, or, perhaps, two happy years to look back at, and one short, happy year and then that trivial formality —the State Board—to look forward to! (Knock! Knock! If it's a Senior, Judson, we're not at home!) But what is there for the Juniors? Surely not much of a retrospect, and not much more of a prospect. And they turn out to be nothing but a lot of "course-crabbers"! (Elucidation upon request).

Oh well! Brace up, you Class of 1939. You won't be Juniors for a long while yet. We extend our sincere greetings to you. Welcome to our fold, etc., etc. To those of you who, in entering upon the study of Optometry, have realized your life-long ambitions, we say, fear not you will not be disillusioned—it is all that you expect it to be. And there *must* be among you some "whose eyes were fixed on worlds afar", whose aim was levelled at perhaps higher and mightier things (as ours was), and who, because of thwarting circumstances, decided to be content with Optometry, as the "next best thing". What can we say to you? —Only that in a very short time you will be grateful to those circumstances, those adverse winds of fate that drove you to these "lesser shores".

Bowling Headquarters of the M. S. O.

FENWAY ALLEYS

FENWAY THEATRE BUILDING, Massachusetts Avenue

Eye, Eye, Suh!

by M. OSSEN

"For nature always in the right
To your decay adapts my sight,
And wrinkles undistinguished pass,
For I'm ashamed to use a glass;
And till I see them with these eyes,
Whoever says you have them lies."
—JONATHAN SWIFT.
(*written to a friend on her birthday*)

Swift, author of "Gulliver's Travels", made a vow never to wear spectacles. When 57 he wrote. "I make nothing of mistaking *uptoward* for *Howard*; *wellpull* for *walpole*; *monster* for *minister;* in writing *speaker* I put n for p".... (If he didn't need glasses he wasn't drinking water).... The new fad in the cosmetic line: a firm is advertising thusly: "Choose your makeup by the color of your eyes." Their keynote is "the color that never changes, *the color of your eyes.* (We always thought they turned green with envy).... Snared from the Reader's Deye-jest: "She learned to say things with her eyes that others waste time putting into words." (Nope, it couldn't be Mae West) .... It's gone but another's coming: Every July 4th about 50 persons in the United States lose the sight of one or both eyes and another 500 receive minor eye injuries .... Nearly all children (including those of the colored race) are born with blue eyes. Generally 4 months is the age that their true color comes forth.... This may be a rumor: The common house fly has more than 4,000 lenses in its eye (A flying trial case, eh!).... Playful fellow: A. E. M., Physical Director at Camp Sevier (1918), "Never miss an opportunity to destroy the eyes of the enemy, in all headholds use the fingers on the eyes. They are the most delicate points in the body and easy to reach. The eyes can be easily removed by the fingers." (Should be helpful in cataract cases).... Speaking about cataracts: Most weight reducing medicines contain the drug Dinitrophenal which is likely to cause 'em (Very nice of them).... The greatest fault with sodium lamps (similar to those adorning our highways) is that their light flickers at the rate of 120 flickers per minute, causing a stroboscopic effect on the eyes.... So what: If you reflect, light from our sun, 92,000,000 miles away is only 8 minutes old when it reaches the earth.... In a recent school survey it was found that there was little astigmatism in the 1st and 2nd grades; but it increases in every grade up to the 6th, where it remains about stationary.... We have the same trouble when the shades across the street are up: Eighty one comparative tabulations of 50 000 items of data showed that not visual acuity but fixation difficulties were the cause of school children getting those "F's".... At last! dear reader we reach the end. (Thank goodness).... Eye'll be seeing you.

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Senior News

The reunion of the Senior class on the initial day of school presented a gala spectacle replete with joyous remembrances and reciprocation of hearty salutations. The cheer that one experiences in renewing acquaintances and the free, confident air of one past summer activity on the threshold of scholastic duty. blended together to accentuate the jovialness of the occasion. Dominant among the gladdening features was the abence of superfluous "slap on the back" and vociferous acclamations in whose stead were real sincere, heart-felt greetings. The spirit of good-will garnered by each individual wended its way into the classroom and molded together to present an interesting study in mass psychology. The meeting of old friends and return of familiar environment was inducive of producing an undercurrent of hyper-sensitivity present throughout the first sessions. Beneath this superficial hypertension was sensed a salient determination of these surprisingly mature, professional men to climax their academic careers in a blaze of glory. Yet it did not seem to be an instinctive feeling of convincing ambition that swept the room, but a true desire to progress as a compact, harmonious group united under a single banner, the profession for which they stand.

Wandering about the school, gaping at the many improvements, listening to tales of vacation days, and planning future events enables one to collect a number of first impressions of fellow seniors:

Paul Malamut—displaying an envious curly top that had remained latent under the dominance of "slickum".

Shuman and Taillon—discussing beauty treatments for their "hair under the nose appendages".

Tuells—"I'm all set to go, after a summer working in a hotel."

Leavitt—Lost in the bliss of last year's cigar.

Roy—Lost in the smoke of Leavitt's cigar.

Berman—A big smile under a new hat.

Di Napoli—"I drove a truck all summer."

Green—Entering the classroom with a ready smile and a jaunty walk.

Russel—Buried in business conferences.

Levine—Amazed by it all, gazing searchingly around the classroom.

Obenauer—"Boy, did I bend frames this summer."

P. Amici—"I had a swell time assisting an Optometrist the last few months."

Shack—From youth to gentleman in one summer.

Shepard—Suave as ever.

Goldberg—Nonchalant to the extreme.

Fineburg—"I'm right in the pink."

Preston—"Swampscott's the place for lovely redheads."

Rakusin—Showing the typical rakusin charm.

Smith—Looking collegiate and carrying a suitcase which rattles.

Pleckavitch—Tanned to the top of his head and ready to start the year's work.

Berger and Pickering—Together again as a happy pair.

Our Own and Our Cousins' Eyes*

by Dr. Thomas Hall Shastid

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My subject is, *"Our Own and Our Cousins' Eyes."* By "cousins" I mean all the plants and all the animals which now exist, or ever have existed, on this planet: for all the plants and animals are descended from a common ancestor—a bit of microscopic protoplasm, which somehow appeared, vast ages ago, in the water of the sea.

Were I to discuss these various kinds of eyes individually I should have before me an almost infinite task; but I propose to consider them only representatively, that is, by means of some of their typical forms. As I do this, I shall try to point out, from time to time, certain special facts which yield important information about the eyes of men.

THE EYES OF THE COMMON ANCESTOR

I have said that all life is supposed to have descended from a microscopic bit of protoplasm which appeared in the water of the sea. Now, what about the eyes of that minute, yet very important, common ancestor of us all? No one has ever seen that protoplasmic Adam. But almost every one has seen a little animal that must be very much like it—our old friend, the ameba. Let us then, first of all, discuss the eyes of the ameba.

The ameba has no eyes, or, rather, it is all eyes. In other words, it is light sensitive throughout its entire mass. You all know that most of the functions of the ameba are generalized throughout the animal's entire body, not specialized in any particular part. Any portion of the ameba may become a foot, then become a part of the body again. Any portion of the ameba can envelope or wrap itself about food; digest food, by secreting hydrochloric acid around it; and, finally, deject, or cast off, the indigestible residue. The ameba has no sex organ, because it is all sex organ. When it procreates it does so by the simple process of dividing in the middle. And so, also, the ameba's two senses, touch and sight, are likewise generalized and not specialized in any particular part. Every portion of the ameba possesses the sense of touch. Every portion of the ameba can also perceive light.

THE FIRST SPECIALIZED EYE

Passing a little higher up in the scale of life, we come to another protozoan, the Euglena viridis. This is a tiny affair, just on the border between the microscopic and the macroscopic worlds. It is of a green color, and has developed, or specialized, a mouth. Just below the mouth is a tiny rose-colored spot. This spot, or boss, of pigment is the Euglena's eye, and it is the simplest eye, and, so far as we know, the first of all the eyes, that can be called eyes, which have appeared upon this planet. All the colored (chromatophoric) flagellates have such eyes and some of the uncolored; but the Euglena viridis' eye is perhaps the simplest of all its class.

This minute eye is both a thermometer and a photometer; that is, it measures the intensity both of the heat and of the light in the Euglena's surroundings. This is shown by an interesting experiment. A rectangular box is divided by two parallel partitions into three compartments and then ooze and water are poured over the floor of them all. Tiny passages are provided through the two partitions. Illuminate one end-compartment brightly, the middle one slightly, and the third not at all. Then place the Euglena in the black compartment. In a short time it will be found in the twilight, or middle compartment. Place it in the brightly lighted compartment, and soon it will again be found to have passed into the

* A lecture delivered at the Mayo Clinic, Rochester, Minnesota, November 24, 1925.

middle, or twilight, compartment. Place it in the middle compartment in the first instance. and it will simply stay there. It knows what is best for it, and it gets to know that by means of the pigment eye. The pigment eye never yields its possessor a picture of the outer world; yet the Euglena, without its eye, would soon perish.

The name. Euglena, is from the Greek and means "good pupil." In truth, this pigment eye is not the ancestor of the pupil, for, as doctors all know, a pupil is not a thing, but a hole in a thing; whereas the Euglena's eye is a thing, a substance—a bit of pigment. It is, in fact—this Euglenic eye—the ancestor of the pigment epithelium layer of our retinas and, in addition, of the pigment in our skins. [1]

THE EYE PIT

Now the Euglena's eye is not a very good eye. One bad thing about that eye is that it is always being injured, because of its highly exposed position just below the animal's mouth, and because it projects out beyond the surface of the animal's body. So Nature seemed to say, "I can surely beat that." And so, in certain other animals, she made a depression in the surface of the body, and set the bit of precious pigment down in the bottom of the depression. This kind of eye can be seen today in some of the worms, notably the Capitellidae. The cup, or pit, appears to exist only for the purpose of giving protection to the pigment. And yet it is, very plainly, the forerunner, or ancestor, of the globe of the human eye.

THE ANCESTOR OF THE TWO HUMORS

But Nature discovered, after a time, that bits of sand and other small bodies would get down into the pit and injure the precious spot of pigment hidden there. And so she filled the pit up with a viscous transparent material, one that would not flow out of the pit, and which would keep the pit filled, and so exclude all foreign bodies, while, at the same time, light was transmitted freely through this filler-material to the sensitive pigment.

Still, no real picture was formed in the eye. But it is likely that eyes like these do yield to their possessors some knowledge of the direction from which light comes. This marked a very important advance. The main thing, however, was that the viscous fluid which filled the little pit was the ancestor of man's vitreous and aqueous humors.

1 For simplicity's sake I have employed, throughout this article, the usual names for the eyes of the Euglena and for all similar protozoan and colonial visual apparatuses—"eye spot", or "pigment eye". In truth, these "pigment eyes" are really composed of two parts: an internal, or pigment layer and an outer (near the surface of the animal's body) or hyaline, layer or portion. The latter component is called by protozoologists the "lens", or the crystalline". This so-called "lens" is, chiefly because of its misleading name, very confusing to a person who wishes to think out the evolution of eyes. It is not a true lens, or picture-forming organ at all, but only a portion of the spot, or stigma, of light-perceiving substance. It is therefore, as one might say, merely an unpigmented part of the pigment spot. So true is this that some observers, notably Mast, believe that, in Gonium (a colonial organism) and similar animals, the so-called lens (each of the separate zooids of the colony has its own eye-spot) is the *only* light-perceiving portion of the eye-spot. The function of the pigment layer, these observers declare, is merely to intercept the light which, passing through the (of course transparent) animal, falls upon the pigment, and so to cast a shadow on the "lens", the true light-perceiving organ.

Of course the so-called lens cannot possibly function as a lens. For one thing, it is not separated from the pigment layer by any interval or space. For another thing, it (or *they* for often there are several "lenses" in one eye-spot) is often partly embedded in the pigment, and in some species (notably in all the colorless forms) it is entirely surrounded by the pigment.

It is hard indeed for an inexperienced comparative ophthalmologist not to think of the so-called lens as at least the ancestor of the modern lens, or image-making organ. But it is not even that. It is simply a part of the primeval light-perceiving apparatus, or "eye-spot". This fact is especially shown by the structure of the eye-spots in that much higher animal and simplest of all chordates, the Amphioxus. In these eye-spots the so-called lens generally terminates in a kind of dentation, or corner, from which extends for some distance a tiny nerve fibre. Now and then several fibres run out from one single "lens". The so-called "lens", therefore, in all these pigment eyes, is most probably the ancestor of the rods in the vertebrate retina; also (it may be) of the cones.

THE FIRST CORNEA

But Nature still seemed to think—if one may so express the situation—chiefly of safety for that bit of precious, light-sensitive pigment. So, inasmuch as foreign bodies did get down easily even into and through this viscous humor, and then did not readily get out of the pit again, Nature ran a shoot of integument across the pit, converting it into a closed pit, and, incidentally, forming the first thing that can possibly be called a cornea. This cornea, as I believe, was first opaque; for Nature has always proceeded by trial, error, and rectification. And it is a fact that some of the worms and snails have just such opaque corneas to this day, *e. g.*, the snail called Limax maximus. In a few species of snails the closing membrane can even be seen not quite crossing over. Nature, however, seeing her mistake, rectified it, making the cornea transparent.

THE FIRST LENSES

Now some of these transparent corneas, according to the law of variation, or mutation, had to be different from other corneas. Some individual corneas, therefore, were no doubt thicker in the center than at the circumference. And behold there had come into the world, lenses. These were not true crystalline lenses, you will observe, but only corneal lenses. But we can easily imagine that the possessor of such lenses, because it received through them some kind of picture, however dim, of the outer world, had a very great advantage over many other animals in "the struggle for existence." Hence double-convex corneas multiplied throughout the world.

THE EYES OF INSECTS

Now we are ready to discuss the eyes of insects, the last of the invertebrate eyes that I will mention. Here I wish to say that I am, as a matter of course, passing by a great many eyes of much interest and even of much greater complexity than those I have mentioned. I am simply moving up what I conceive to be the central trunk of the eye-development tree and paying no attention at all to the lateral branches, however important.

Insects' eyes are of two kinds: simple and compound. We may take, as typical examples, the simple and compound eyes of the ordinary house-fly. If you look at a common house-fly, you will see, even with your naked eyes, that the fly's head consists almost entirely of two large, dark-brown lobes. These lobes are the compound eyes, and each eye is a truly wonderful affair. That is to say, each consists of more than 4000 eye-units, called *ommatidia*, placed side by side. Each eye-unit is hexagonal in circumference, like a single cell of honey. At one end of each long, cylindrical, hexagonal eye-unit, there is placed a bit of pigment—retina, rather—for each bit of pigment is now connected with the central nervous system by means of a tiny nerve fibre. And the outer end of each eye-unit has a cornea. This cornea, in its center, is thicker than at its hexagonal circumference. This makes of each cornea a double convex lens. And each double convex lens, or cornea, throws its own tiny image of a small part of the outer world upon its corresponding retinula, or speck of retina. There is then conveyed to the fly's central nervous system, from each compound eye, a mosaic picture; a picture compounded, naturally, of more than 4000 minute picture-fragments.

These are the fly's compound eyes, two in number. What about the fly's single eyes? These are three in number, and they are situated, in the form of a triangle with its point downward, in the space above and between the two compound eyes.

Thus far we have said nothing about the focusing of eyes for various distances. Now, Nature gave to the fly two kinds of eyes, because she had felt the need for focusing, or the adjustment of eyes for different distances. She did not, however, at first, think of a very good way to accomplish this adjustment. She made for the fly two kinds of eyes: the compound eyes for distance,

i. e., a distance of three to four yards, and the single eyes for near: "near" meaning, in the fly's case, from one to two inches. Some insects have only compound eyes. Some have only single eyes. Most of them have both single eyes and compound. You will please to note that none of these insect eyes have any movements. The eyes are set on the fly's head as solid as so many jewels in a watch. There are, however, in some of the invertebrates, eyes that move, as, for example, the snail's eyes. That comes about from the snail's eyes being placed on the ends of two long antennae. But in no invertebrate, so far as I am aware, is there even a rudiment of an eyelid. Neither is there any iris or pupil, in the true sense of these terms.

THE EYES OF FISHES

And now we leave the invertebrates and come to the great backboned class of animals, the first of which are the fishes. At once we find a great improvement in eyes. But how the fish got their immensely improved eyes is extremely difficult to say. Some people believe that the eyes of fishes are directly derived from the eyes of some of the invertebrates, possibly the insects or the worms, marine worms. Others say, "No," because, in practically all invertebrates, the rods of the retina are turned in the opposite way from that in which they are turned in all the backboned beings. Others, again, say that, inasmuch as six out of a spider's eight eyes have the retinal rods turned like those of the human eye, therefore the vertebrates are all descended from the spiders, or at least from some kind of arachind. Still others say that vertebrates did not inherit their eyes from the invertebrates at all, but that they started the development of eyes all over, made a fresh beginning. In proof of this they cite the Amphioxus, with its pigment eyes. The Amphioxus, as you all remember, has a notochord, though no true vertebral column. It is something which is trying to become a vertebrate, yet which does not quite succeed. It seems to be the immediate ancestor of the fish. At all events, some people think that eyes started all over with the Amphioxus, on an entirely new and better plan. But some comparative ophthalmologists point out that the Amphioxus's eyes are not beginning-eyes at all, but degenerate eyes, that is, eyes that have fallen from a better state because of the Amphioxus' habit of burrowing and even living in dark ooze and wet, sharp sand. So these eyes are not making a beginning of any sort, but only an ending. Then there are still other thinkers who say that eyes did indeed begin all over with the Amphioxus, but that this later scale, or ladder, of eye development started not with the Amphioxus' pigment, or degenerate eyes, but with certain spinal visual cells which, in the primitive (transparent) Amphioxus, lie all along the spinal column, and which are sensitive to light. As the Amphioxus became less transparent in some of its species, and grew more like a fish, its spinal visual cells moved to the surface of the body and became, two of them at least, true vertebrate eyes. Still other persons declare that the eyes of the vertebrates are not descended either from pigment eyes or from spinal eyes, but from tactile corpuscles in the skin of some of the most primitive backboned animals. Whatever the truth among these theories may be, we see one thing clearly and that is that the subject of eye-development becomes, as we pass from the invertebrates to the fishes, one of very great obscurity indeed. This obscurity, however, I may remark in passing, is no greater than that which surrounds the pedigree of man in general. As one scientist has truly phrased the situation, "We do not yet know, after more than a century of morphologic study, even whether man and the other vertebrates have descended from a segmented, or an unsegmented, ancestor."

At all events, we now come to consider the eyes of fishes. Of a sudden all is changed. People are accustomed to say, ridiculously: "The poor fish." But the fishes have presented to the world many fine matters of inheritance. For one thing, the

backbone itself. As if this wondrous gift were not alone sufficient, the fishes have introduced also a true crystalline lens; not a merely corneal lens, but a lens posterior to the cornea and separated from it by transparent fluid. They also introduced true focusing arrangements. In addition they have given us the iris and the pupil, also extrinsic eye muscles, and they almost, but not quite, introduced eyelids.

RETINAL REST

And now, speaking of eyelids, I shall have to digress for a moment to the eyes of men, in order to bring out clearly the importance of eyelids. This importance is due to the need for retinal rest. Retinal rest, in man, is secured chiefly in two ways: (1) by motion blindness and (2) by involuntary winking. Let us first consider motion blindness.

Whenever our eyes are in motion, they are stone blind, excepting only when they move without changing the point of fixation. Astounding as is this fact, it is scarcely ever borne in mind, even by ophthalmologists. Yet any one can easily convince himself of the truth of the statement. Let him stand before a mirror, and look at the image of one of his eyes. Let him look first at the right side of that eye, then at the left side of the same eye, and then back again. Never, so long as he lives, will he see his eye in motion. The reason is that, just so soon as an eye begins to move, it is blind. We are never conscious of the blind interval, chiefly because the picture, which is last seen before the eye begins moving, persists in the center of the brain and thus laps over the interval during which the retina is blind. But the chief fact is that the retina, by means of its motion blindness, gets minute intervals of rest with very great frequency all through our waking hours. In this way, too, the blurry and useless pictures which we should receive if the eyes saw while in motion are avoided.

But there is yet another way in which retinal rest is secured: namely, by the involuntary winking of the lids. From three to six times a minute this involuntary winking takes place, and it very much adds to the quantity of rest which the retina receives.

There are other uses of eyelids: protection against injuries by foreign bodies and from other traumata; the frequent spreading of the tear (which is secreted at the upper and outer angle of the eye) in a thin layer across the front of the eye, to keep the eye moist and bright; then, too, the moving of the tear on to the mouth of the tear sewer, which begins at the inner angle of the eye and runs down into the nose.

In some diseases retinal rest is greatly interfered with; for example, in exophthalmic goitre. In this affection winking becomes less frequent, or disappears entirely. Then, too, the eyeballs, being strongly protruded and rather tightly fixed, are more or less motionless, and so the retinal rest from "motion blindness" is also practically abolished. Hence, in this disease, the poor retinas are practically worn out from lack of rest. Bandaging the eyes, in these cases, does more than prevent ulceration of the cornea: it also provides sufficient rest for the exhausted retinas. In paralysis agitans, facial paralysis, and ophthalmoplagia externa, we have a similar situation, and one which, as an element in the case, is almost universally ignored. And, in fact, in many otherwise unexplainable cases of asthenopia, we find, if we carefully investigate, that the cause is some kind of interference with retinal rest. Some hysteropes wink only once a minute, instead of three to six times, and so on. I have made numerous investigations into this subject (not yet published) and I confidently recommend the topic of "retinal rest" to the oncoming generation of ophthalmologists as one of the most promising for original investigation of any which I know.

THE BEGINNINGS OF EYELIDS

Now to return to fish and eyelids. There

were no eyelids in the world before fish. And fish simply made a beginning of eyelids. No fish, to this day, has a functioning upper or lower eyelid. But, in a very few species, there do exist fixed dermal folds above and below. And in some sharks there is a membrana nictitans, or eyelid in the inner corner of the eye. This lid is really a functioning lid. By the contraction of its muscles it runs outward across the front of the eyeball, and back to the inner corner of the eye. This membrana nictitans, as we shall see hereafter, is the chief functioning eyelid of snakes and birds, and a vestige of it still remains in the human eye in that which is called the "plica emidunaris."

FISHES' EYES AND DEPTH OF WATER

Before considering fishes' eyes further, let us classify these eyes according to the depth of the water their possessors inhabit. Fish that live in the uppermost layers of the sea have pretty good eyes, because they live live in deeper and deeper water have in- in fairly well illummined water. Those that creasingly larger and larger eyes, with larger and larger pupils, in order to catch what little light is stirring about them. These eyes are also nearer the top of the head, because the light which they do get comes from above. At length, in the very deepest depths, where no light ever is found, except, perchance, some mysterious bit of phosphorescence, the eyes become smaller and smaller. Finally, in the blackest abysses of the sea, eyes generally become mere rudiments or disappear altogether. Fish, too, that live in dark caves are totally blind, some even eyeless.

(*Continued in the October issue*)

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